

OPTICAL INSTRUMENT HAVING A BINOCULAR VIEWING PORT

5 CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This invention claims priority of the German patent application 101 08 988.0 which is incorporated by reference herein.

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FIELD OF THE INVENTION

[0002] The invention refers to an optical instrument.

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BACKGROUND OF THE INVENTION

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[0003] In microscopes, for example, and in particular in stereomicroscopes, it is often desirable to reflect data and/or images into the one binocular channel or stereo channel, and to attach to the other binocular channel or stereo channel an imaging device, such as a photographic camera or a video unit, which acquires the microscope image, i.e. for example a specimen image or (for a surgical microscope) the surgical site.

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[0004] In an optical instrument or device having at least one binocular viewing port, for example a stereomicroscope, it is known to provide in the two channels of the binocular beam path beam splitters that make it possible to reflect a portion of the beam path out onto the imaging device or the like, and/or to reflect in toward the viewing port data or images that have been made available.

[0005] Many users are now requesting the ability to choose without restriction whether the image is reflected into, or the imaging device is attached to, the left or the right channel. Often it is even 5 desirable to be able to change, during operation, which device is attached to which channel.

[0006] In the existing art, therefore, both the imaging device and the display device that makes available the data or images that are to be reflected in are 10 configured as modules, so that they can be selectively flange-mounted onto the left or right stereo channel. Changing modules from one side to another is troublesome, however, and the risk of confusion also exists. Because of the need for unrestricted access to 15 the individual modules, the space or volume required is moreover very large.

SUMMARY OF THE INVENTION

20 [0007] It is the object of the invention further to develop an optical instrument which allows a switching between having the channels into which data and/or images are reflected, or out of which a portion of the beam path is reflected out to an imaging module, without 25 the need to reinsert or remount modules.

[0008] According to the present invention the above object is achieved by an optical instrument which comprises:

- 30 • at least one binocular viewing port defining at least one binocular beam path which has two channels;
- an imaging module,

- a display module,
- a plurality of beam splitters for reflecting a portion of the beam path out onto the imaging module toward the viewing port, and for reflecting into one channel [data or images] that have been made available on the display module, wherein the imaging module and the display module are arranged in stationary fashion with respect to the optical instrument; and
- at least one optical switcher provided for the imaging module and the display module that optically connects the respective module to the beam splitter in the one or the other channel.

[0009] According to the present invention, the module or modules are arranged in stationary fashion. In order to connect the individual modules optically to the particular desired channel of the binocular beam path - which is preferably but not necessarily a stereo beam path - there is provided for each module (at least) one optical switcher that optically connects the respective module to the beam splitter in the one or the other channel, i.e. creates an optical path. Optionally, the optical switcher can also have a position in which it does not create a connection between the respective module and one of the channels of the binocular beam path.

[0010] It is preferred in this context if the optical switchers are rotatable or slidable prisms. Rhomboid prisms, for example, can be used as the prisms. Of course other "optical switches," such as simple mirrors or electrooptical elements can nonetheless also be used, provided their only function is to open up or close off

an optical path between the respective module and the beam splitter provided in the one or the other channel.

[0011] It is also possible, in addition, to provide more than one optical switcher for each module.

5 [0012] For example, the one switcher, which for example is configured as a rhomboid prism, can, depending on its angular position, reflect the data or images made available by the display module into the left or into the right channel of a binocular tube. The other

10 switcher, which can be introduced in place of the rhomboid prism into the beam path, can be configured, for example, in such a way that it reflects the data or images into both channels. For that purpose, this switcher can comprise a beam splitter and two downstream rhomboid prisms. When this switcher is introduced into the beam path, it is preferred if the switcher of the imaging module is in a position in which no light is directed out of the beam path onto the imaging module.

15 [0013] The optical instrument or device configured according to the present invention has a number of advantages.

[0014] Since the individual modules do not need to be reinserted during operation, the simple result is that they do not need to be arranged for unrestricted access.

20 Instead, they can be provided in space-saving fashion in the interior of the instrument or device. As a rule, the configuration according to the present invention in fact makes it possible to arrange them in the device in such a way that they need to be removed only for servicing purposes. Only if the modules are to be used 25 with multiple instruments or devices must they be

configured in such a way that they can easily be detached from the device or instrument.

[0015] If the instrument or device has more than one binocular viewing port, the individual modules can then also be used for different binocular beam paths or indeed simultaneously for two or more binocular beam paths. Regarding instruments or devices having more than one binocular viewing port, the reader is referred by way of example to U.S. Pat. No. 4,138,191 and to the existing art recited on the cover page of that document. For example, it is possible to optically connect a display unit or a display module via corresponding optical switchers to any desired channel of the stereo beam paths provided for different observers, or even simultaneously to one respective channel of the two stereo beam paths of the surgical stereomicroscope described in U.S. Pat. No. 4,138,191.

[0016] In the optical instrument or device configured according to the present invention, it is particularly preferred if an imaging module and a display module are provided which can then selectively be optically connected to the left or right channel of the binocular beam path. Nonetheless, of course, more than two modules can also be provided. These can be, for example, various imaging modules such as, for example, a photographic camera and a video unit, and/or various display modules of which one makes available data and the other images. In addition, however, other modules such as, for example, illumination units or laser modules for marking and/or treating or processing the specimen field can also be provided.

[0017] If an imaging or recording module and a display module are used simultaneously, it is preferred if they are optically connected to different beam paths of the binocular beam path, in order to prevent the occurrence of moiré effects. This is achieved in particularly simple fashion if the optical switchers of the recording module and of the display module are mechanically or electronically coupled to one another in such a way that the two modules cannot be connected simultaneously to the same beam path. In the case of rhomboid prisms, this can easily be done by the fact that the two prisms, depending on the light path in the prisms, are arranged on the same shaft, or that the two prism shafts are counter-coupled.

[0018] It is further preferred if the beam splitters are beam splitter prisms or beam splitter cubes, which allow both reflection in toward the viewing port and reflection out of the beam path.

[0019] The beam splitters are often permanent constituents of the respective channel; it is also possible, however, to join the beam splitter, for example, to the movable prisms or even to configure them integrally therewith. Although this increases the outlay for movement of the prisms, this embodiment nevertheless has the advantage that the beam splitter can be matched to the particular module. In the case of a laser module, for example, it is possible to design the beam splitter in such a way that it is opaque to the wavelength of the laser and thus deflects all of the laser light onto the specimen field, so that no laser light can emerge from the binocular viewing port.

[0020] It is moreover also possible to configure the optical instrument or device in such a way that each channel can be optically connected - generally via different beam splitters - to more than one module.

5 [0021] The invention is usable in particularly preferred fashion in microscopes and in particular in stereomicroscopes, in which the beam splitters are arranged, for example, in the parallel beam path between the microscope objective and the tube lens. The invention is nevertheless, of course, also usable in other instruments or devices, for example telescopes, binocular loupes, etc., in which reflection out of or into the beam path is possible. It is moreover expressly stated that the term "binocular viewing port" 10 does not necessarily imply that the instrument or device 15 is a stereo instrument or device.

BRIEF DESCRIPTION OF THE DRAWINGS

20 [0022] The invention will be described below in more detail on the basis of exemplary embodiments and with reference to the drawings, in which:

25 FIG. 1 shows the beam routing through the beam splitter prisms or cubes used in the binocular beam path of a stereomicroscope; and

FIG. 2 shows a plan view of the beam splitter cubes depicted in FIG. 1 and the associated optical switchers, according to an exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

5 [0023] The invention will be described below, with no limitation as to general applicability, with reference to a stereomicroscope beam path (only partially depicted). In FIGS. 1 and 2, identical parts or elements are always labeled with the same reference characters, so that the individual parts need not always 10 be presented again.

15 [0024] FIG. 1 shows in perspective the beam routing through the beam splitter prisms or cubes used in the binocular beam path of a stereomicroscope. The beam splitter cubes used in the left beam path l and right beam path r are labeled with the reference characters α and β . Beams a and b (depicted with solid and dashed lines) coming from the microscope objectives encounter lower plane 11 (not visible in FIG. 1) of beam splitter cubes α and β , enter the beam splitter cubes, and are 20 divided by the respective partially reflective plane 1 of beam splitter cubes α and β in accordance with the ratio (for example, 50:50) defined by the configuration or coating of said plane 1. Components a' or b' (depicted with dashed lines) that have been deflected 25 90° pass through rear plane 12 (also not visible in FIG. 1) of the beam splitter cubes and emerge therefrom, and can be imaged, for example, by an imaging module (not depicted in FIG. 1) such as a video unit and a photographic camera. The components (depicted with solid lines) that continue through plane 1 emerge from 30 the respective (upper) plane 13 of the beam splitter

cubes, pass through components (not depicted) of the stereomicroscope configured in usual fashion, and are then perceived by a viewer. Light arriving from a display unit (not depicted in FIG. 1) along beam paths A 5 and B (depicted with dot-dash lines) at the respective (front) planes 14 of the beam splitter cubes is also divided by plane 1. Components A' and B' that have been deflected 90° are also perceived by the viewer. The component passing through plane 1 emerges from plane 12 10 together with beams a' and b'. If light a' and b' coming from the microscope objective is to be imaged by an imaging module, these beams interfere with image acquisition.

15 [0025] It is therefore usual to image only the light rays coming from the microscope objective that are reflected out of the beam path into which nothing is being reflected in.

20 [0026] FIG. 2 depicts an exemplary embodiment of the invention which makes it possible to select in simple fashion whether reflection is to occur into the left (l) or right (r) beam path, and to image with an imaging module the light emerging from the other beam path.

25 [0027] FIG. 2 shows a plan view of the arrangement depicted in perspective in FIG. 1, i.e. a view in the direction of the surface normal lines of plane 13. An imaging module (only schematically depicted) is provided on the one side of the microscope beam path; a display module 3 (also only schematically depicted) is provided on the other side. The two modules 2 and 3 are arranged 30 in such a way that their optical axes extend in the center between beam paths A and b' and a and B. Two rhomboid prisms 4 and 5, serving as optical switchers,

are arranged between beam splitter cubes α and β and
modules 2 and 3, respectively. Depending on the
positions of rhomboid prisms 4 and 5, they connect
imaging module 2 to left beam splitter cube α and
5 display module 3 to right beam splitter cube β , or
imaging module 2 to right beam splitter module β and
display module 3 to left beam splitter cube α . It is
particularly preferred in this context if the two
10 rhomboid prisms 4 and 5 are arranged on a common shaft 6
(depicted with a dash-double-dot line), so that
switching always occurs synchronously through 180° and
the two modules are never simultaneously connected to
the same channel. The reader is referred to FIG. 2 for
further details.